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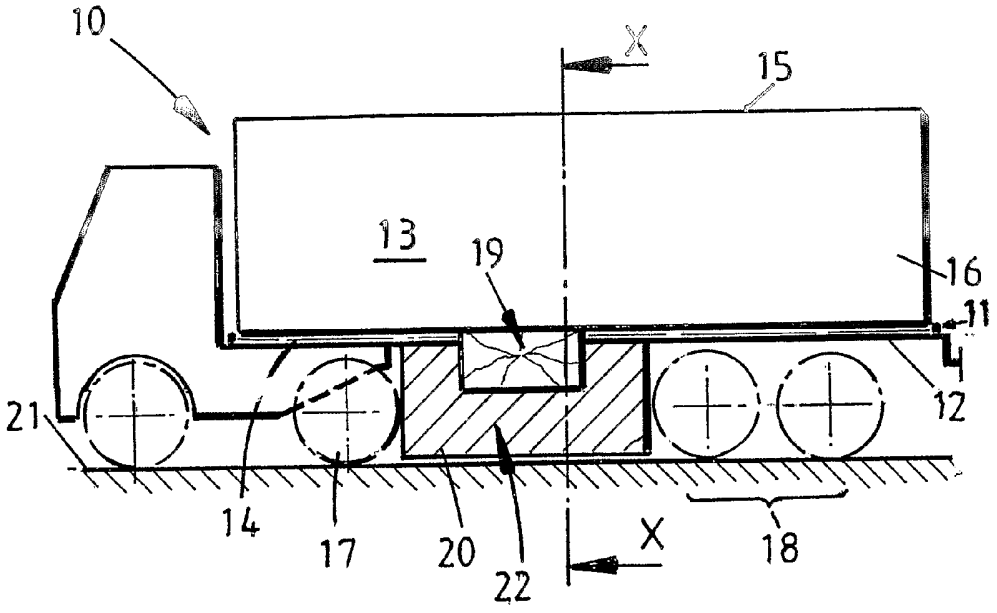
(54) Title: LOAD TRANSPORTATION



(57) **Abstract:** A load such as a container (13) is supported on a trailer (11) of a vehicle (10). A flexible skirt (20) depends below the container (13) through an opening in the trailer (11) so as to define a plenum chamber (22) between container and the ground (21) on which the vehicle (10) is travelling. A compressor (23) is supported below the container (13) in the chamber and directs compressed air into the chamber (22) so as to generate a load-bearing air cushion under said container (13). The air cushion supports the load, thereby reducing the weight carried by the vehicle (10). The chamber (22) is defined between rotating skirts (20) on each side and fore and aft rollers. The energy required to drive the compressor (23) is less than that required to transport the full weight of the load.

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LOAD TRANSPORTATION

The present invention relates to the transportation of loads by a vehicle.

Transporting heavy loads by road or rail involves relatively high vehicle fuel consumption rates that, as is well documented, have a detrimental impact on the environment in terms of pollution etc.. Moreover, transporting heavy loads increases the normal wear rate of various parts of vehicles such as, for example, tyres and also has an impact on the wear of road surfaces or rails etc.

It is an object of the present invention to mitigate or obviate the aforesaid problems.

According a first aspect of the present invention there is provided a vehicle having a load support member for supporting a load, a skirt depending below said support member so as to define a plenum chamber between said load and the ground on which the vehicle travels, a blower having an inlet for receiving air and an outlet in communication with said plenum chamber so as to force air into the chamber thereby forming, in use, a load-bearing air cushion under said load, wherein sealing means is provided to seal the skirt to the ground so as to prevent significant escape of air from the plenum chamber.

The air cushion supports the load, thereby reducing the weight carried by the vehicle. This not only reduces the fuel consumption of the vehicle but also enables heavier loads to be carried without damage to the road or rail surfaces.

Preferably the support member is a trailer or other platform. In one preferred embodiment the load or load support member is supported on a wheel base.

Preferably there is provided a suspension system between the load support member and the wheel base.

The blower may be in the form of a fan that blows air into the plenum chamber using an impeller or the like, or a compressor that pumps compressed air into the plenum chamber.

According to a second aspect of the present invention there is provided a method for supporting a load on a vehicle, the method comprising the steps of supporting the load on the vehicle, providing a plenum chamber that extends between said load and the ground on which the vehicle travels, directing air into said plenum

chamber so as form a load-bearing air cushion under said load and sealing the skirt to the ground so as to prevent significant escape of air from the plenum chamber.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic side view of a vehicle in accordance with the present invention;

Figure 2 is a schematic fragmented view taken along the line X-X of figure 1;

Figure 3 is a schematic side view of a slightly modified embodiment of the present invention;

Figure 4 is a schematic fragmented view taken along line Y-Y of figure 3;

Figure 5 is a plan view of an alternative embodiment of a vehicle trailer in accordance with the present invention;

Figure 6 is a side view of the trailer of figure 5;

Figure 7 is a sectioned view along line A-A of figure 6;

Figure 8 is a sectioned view along line B-B of figure 6;

Figure 9 is a sectioned view along line D-D of figure 6; and

Figure 10 is a more detailed sectioned view of one side of the trailer of figures 5 and 6.

Referring now to the drawings, a lorry 10 in accordance with the present invention has a trailer 11 with a base wall 12 on which is supported a loaded container 13 having lower, upper and side walls 14, 15 and 16. A middle section of the base wall 12 of the trailer 11 between front and rear wheels 17, 18 of the trailer 11 has an opening 19 over which the lower wall 14 of the container 13 is supported.

A middle section of the lower wall 14 of the container 13 is fitted with a depending skirt 20 that extends through the opening 19 towards the ground 21 on which the lorry is supported so as to define a plenum chamber 22 between the container 19 and the ground 21. The skirt 20 is made of a material that is flexible enough to deflect when it encounters obstructions such as uneven ground but rigid enough to maintain the walls of the chamber in place during use. If necessary an upper part of the skirt may be rigid and the lower part near the ground may be flexible. The lower edge of the skirt is designed to seal to the ground so as to prevent the escape of

significant amounts of air from the plenum chamber. Inside the chamber 22, the lower wall 14 of the container 13 is fitted with two air compressors 23 having outlets for directing compressed air into the chamber.

In operation the compressors are activated to generate an air cushion in the chamber 22 between the container 19 and the ground 21. The air cushion serves to bear the load the container load and thereby reduce the load applied to the vehicle trailer. The load is effectively supported on the ground over which the vehicle travels via the air cushion. Hydraulic rams 24 are disposed on each side between the container and the trailer to ensure that the lift generated by the compressor is applied equally across the container.

The trailer may be in the form of a platform that is supported on the vehicle wheels by a conventional suspension arrangement. The air cushion generated in the plenum chamber provides a reaction force that supports the platform (and the load thereon) relative to the wheels and axles.

The compressor or fan 23 may be driven from the engine of the vehicle or from a separate source and its operation may be controlled from within the driving cabin of the vehicle. An inlet to the compressor receives air from the atmosphere. Preliminary calculations have shown that the power consumed in operating the air compressor is less than that required to drive the full weight of the load forwards.

In the alternative embodiment shown in figure 3 parts corresponding to those of figures 1 and 2 are indicated by the same reference numerals increased by 100 and are not further described except in so far as they differ from their counterparts in figures 1 and 2. The plenum chamber 122 is defined between fore and aft ground contacting rollers 130, 131 that extend between and a pair of translating skirts 120, one disposed on each side. Each skirt 120 comprises a endless loop of flexible material arranged over vertical spindles 132 at each end and defines a first path 120a facing outwardly of the vehicle and a return path 120b facing the chamber 122. At least one of the spindles 132 is driven in rotation so as to translate the skirt 120 in the manner of a conveyor belt disposed on its side. The skirt 120 is arranged so that its return path 120b is displaced vertically from the outwardly facing path 120a as is shown in figure 4. The skirt 120 is driven in translation by one of the spindles 132

being drivingly connected directly or indirectly to the rollers 130, 131 or wheels 118 of the vehicle so that it travels at the same rate as the vehicle. The outer path 120a of the skirt 120 moves in the opposite direction (B) to the direction of travel (A) of the vehicle so that there is no significant relative displacement between the ground 121 and the outer part 120a of the skirt. This significantly reduces the risk of damage to that part of the skirt that is closest to the ground. The return part of the skirt, which travels in the opposite direction to the first part, is offset to provide greater clearance from the ground and reduce the likelihood of damage. Again the lowermost edge of the skirt is designed to seal to the ground.

A further alternative embodiment is illustrated in figures 5 to 10. An elongate trailer 211 is supported on the ground by three pairs of wheels 240 and corresponding axle assemblies via a suspension arrangement (not shown) of conventional configuration. The trailer defines an upper surface 241 for supporting a container or load (not shown). A fan 223 is mounted on the upper surface 241 of the trailer 211 and is designed to force an air stream through a duct in the trailer floor into an air plenum chamber 222 defined under the trailer 211 as before. The fan has an intake duct 223a adjacent to the front end of the trailer.

The reaction force created by the air pressure in the plenum chamber 222 is used to support the trailer and its load relative to the wheel and axle assemblies. As in previous embodiments the plenum chamber is defined between the trailer and the ground with depending skirts 220 to the side of the trailer. Front and rear skirts 242, 243 complete the chamber but these can be replaced in an alternative embodiment by front and rear ground-contacting rollers.

In this embodiment the side skirt 220 comprises a combination of elements. The trailer 211 has two parallel load-bearing I-beams 244 below the trailer floor on each side. These beams form support for a sub-assembly 245 that contacts the ground on each side and is sealed to the underside of the trailer by a flexible membrane or curtain 246. The plenum chamber 222 under the trailer 211 is thus sealed to the ground by a combination of the sub-assembly 245 and the flexible membrane 246.

The sub-assemblies 245 extend along a substantial length of the trailer on each side outboard of the wheels 240. Each assembly comprises an elongate frame 247

which supports a pneumatic tyre 248 in the form of an endless loop. The frame comprises upper and lower horizontal beams 249, 250 and transverse struts 251. At each end there is a horizontal arm 252 on which a wheel 253 is rotationally mounted. The tyre 248 is disposed over each wheel 240 and supported by the upper and lower beams and arranged so that it contacts the ground on each side. As the vehicle moves the tyre 248 circulates around the wheels 240 and over the frame by virtue of its frictional contact with the ground. The tyre 248 thus effectively remains stationary relative to the passing ground as it travels at the same rate. The arrangement thus provides a seal on each side skirt. Inset into the upper and lower beams is a low friction wear resistant strip 254 on which the tyre is supported and relative to which it translates.

The sub-assembly is mounted to the I-beams 244 of the trailer 211 via a pair of bracket assemblies 255 spaced along the length of the trailer. Each bracket assembly 255 supports, on each side, a pair of pivotal link arms 256 that connect to lugs 257 provided on the inwardly facing part of the frame 247. The link arms 256 are pivotally connected to both the bracket assembly 255 and the frame and allow the sub-assembly 245 to move in the vertical direction to accommodate the differing ground conditions. A hydraulic or pneumatic cylinder 258 is connected between the trailer and one of the pivot arms 256 to urge the sub-assembly towards the ground and to effect damping of the motion. The cylinder can also be operated to lift the sub-assembly clear of the ground when required.

On the underside of the trailer floor, towards its peripheral side edge, the trailer has a depending flexible membrane, sheet or curtain of, for example, polyurethane. The membrane extends from the edge of the trailer between the vehicle wheels and the sub-assembly and seals against the frame of the sub-assembly which in turn seals against the ground by virtue of the pneumatic tyre. The frame 247 of the sub-assembly is sealed against the escape of air by a rubber liner 259. The sub-assembly 245 and membrane thus provide for a sealed side skirt 220 that co-operates with the ground so as to prevent significant escape of air from the plenum chamber.

The rearmost of the wheels 253 is mounted in a slot in the arm 252 so that its position can be adjusted along the length of the trailer.

The pressure of the air cushion can be controlled by controlling the air flow in or out of the plenum chamber by operation of the fan which may be provided with a throttle valve.

It will be appreciated that numerous modifications to the above described design may be made without departing from the scope of the invention as defined in the appended claims. For example, the load-bearing air cushion may be used to support loads in any type of land or sea vehicle. Furthermore any number of fans or compressors or other blowers may be used and these may be disposed below the trailer instead of being supported on its upper surface. The load may be secured to a platform that rests on the trailer of the vehicle and the air cushion may act on the platform and the skirt may depend from the platform.

CLAIMS

1. A vehicle having a load support member for supporting a load, a skirt depending below said support member so as to define a plenum chamber between said load and the ground on which the vehicle travels, a blower having an inlet for receiving air and an outlet in communication with said plenum chamber so as to force air into the chamber thereby forming, in use, a load-bearing air cushion under said load, wherein sealing means is provided to seal the skirt to the ground so as to prevent significant escape of air from the plenum chamber.

2. A vehicle according to claim 1, wherein the support member is a trailer or other platform.

3. A vehicle according to claim 1 or 2, wherein the load or load support member is supported on a wheel base.

4. A vehicle according to claim 3, wherein there is provided a suspension system between the load support member and the wheel base.

5. A vehicle according to any preceding claim, wherein the blower is in the form of a fan that blows air into the plenum chamber using an impeller or the like.

6. A vehicle according to any preceding claim wherein the blower is a compressor that pumps compressed air into the plenum chamber.

7. A vehicle according to claim 5 or 6, wherein the blower is disposed in the chamber below the load.

8. A vehicle according to any preceding claim, wherein the blower is driven from an engine of the vehicle.

9. A vehicle according to any one of claims 1 to 7, wherein the blower has drive means separate from the engine of the vehicle.

10. A vehicle according to any preceding claim, wherein at least part of the skirt is flexible.

11. A vehicle according to any preceding claim, wherein at least part of the skirt moves relative to the vehicle in a direction opposite to the direction of travel of the vehicle.

12. A vehicle according to claim 11, wherein at least part of the skirt is in the form of an endless loop of material driven in translation.

13. A vehicle according to claim 11 or 12, wherein the moving part of the skirt forms at least part of the sealing means.

14. A vehicle according to any preceding claim, wherein the skirt comprises side, front and rear walls.

15. A vehicle according to claim 14, wherein the side walls on each side of the load supporting member support a wheel at each end and a tyre is entrained around the walls and the wheels, said tyre being designed, in use, to contact the ground and form at least part of the sealing means.

16. A vehicle according to claim 15, wherein the side walls are in the form of a frame.

17. A vehicle according to claim 16, wherein the frame is sealed against escape of air.

18. A vehicle according to claim 16 or 17, wherein there is provided a membrane between the load support and the side walls and which seals to both.

19. A vehicle according to any one of claims 14 to 18, wherein the tyre is supported on a wear resistant member on the frame.

20. A vehicle according to any one of claims 14 to 19, wherein the tyre is pneumatic.

21. A vehicle according to any one of claims 14 to 20, wherein the front and rear walls are in the form of rollers that contact the ground in use.

22. A vehicle according to any one of claims 14 to 20, wherein the front and rear walls are in the form of flexible membranes.

23. A vehicle according to any one of claims 14 to 22, wherein the side walls are movable in a vertical direction relative to the load supporting member.

24. A vehicle according to claim 23, wherein the side walls are connected to the load supporting member via a linkage that enable them to move in the vertical direction.

25. A vehicle according to claim 24, wherein the linkage is connected to a pneumatic or hydraulic cylinder.

26. A vehicle according to any one of claims 11 to 13, wherein the movement of the skirt is driven by from a wheel or other ground-contacting member of the vehicle.

27. A method for supporting a load on a vehicle, the method comprising the steps of supporting the load on the vehicle, providing a plenum chamber that extends between said load and the ground on which the vehicle travels, directing air into said plenum chamber so as form a load-bearing air cushion under said load and sealing the skirt to the ground so as to prevent significant escape of air from the plenum chamber.

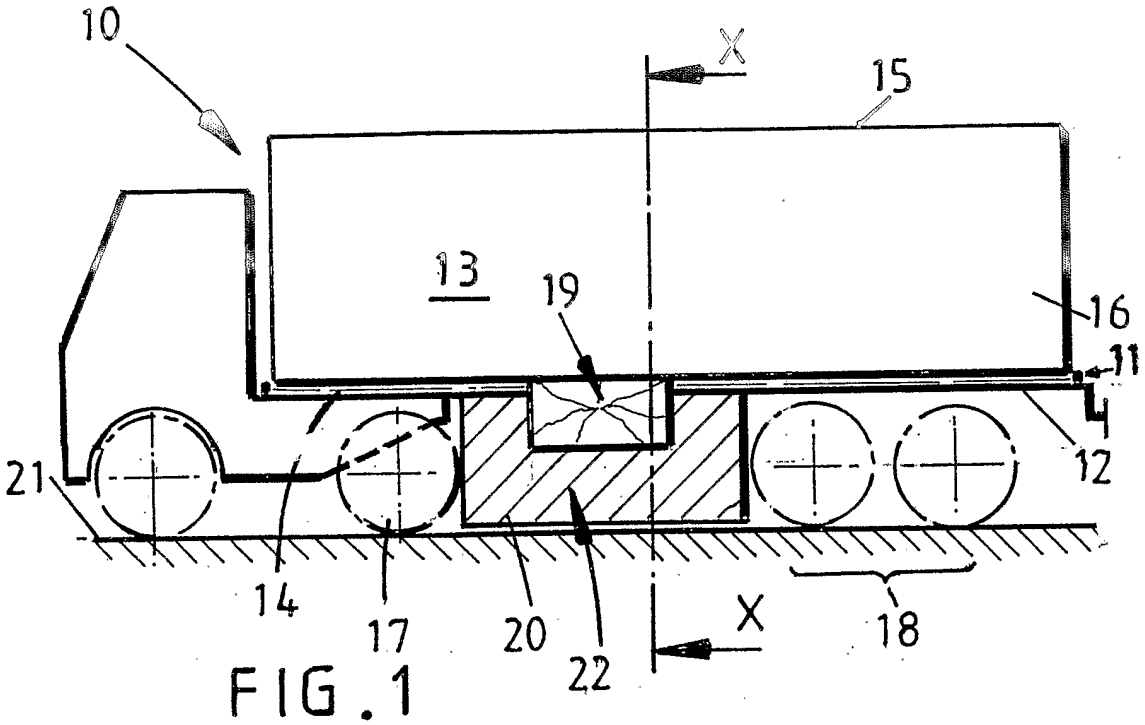
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FIG. 1

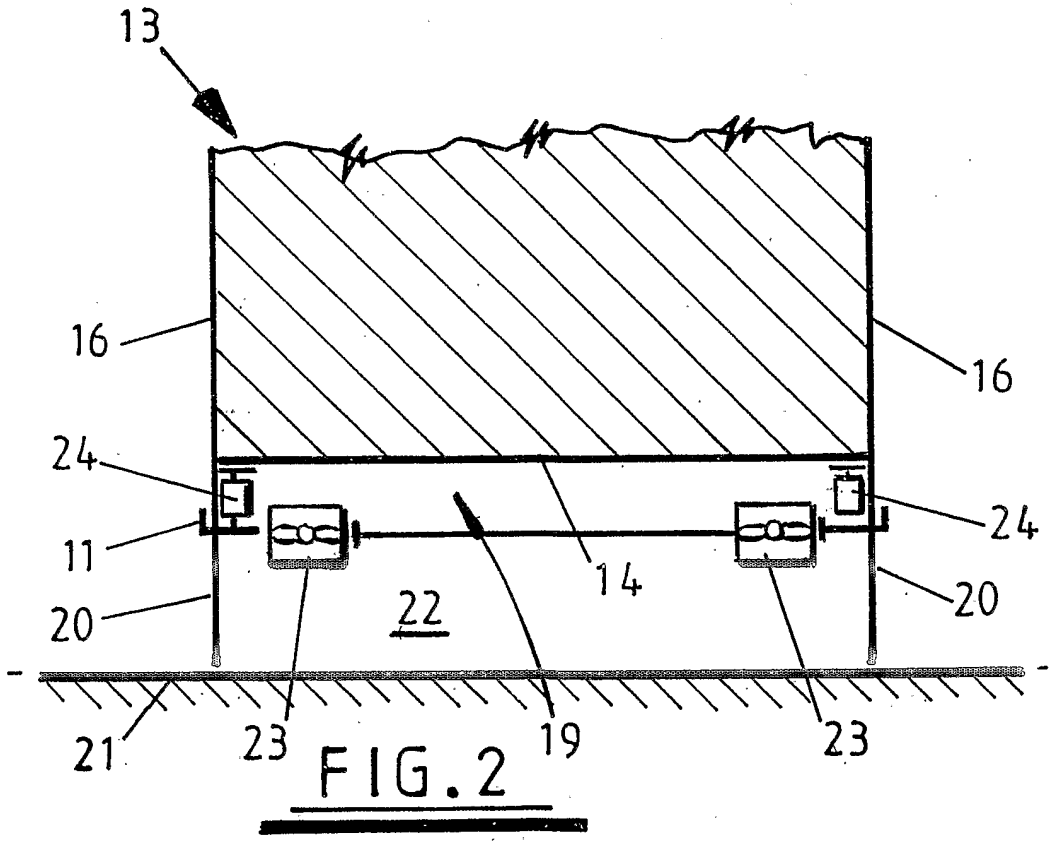
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FIG. 2

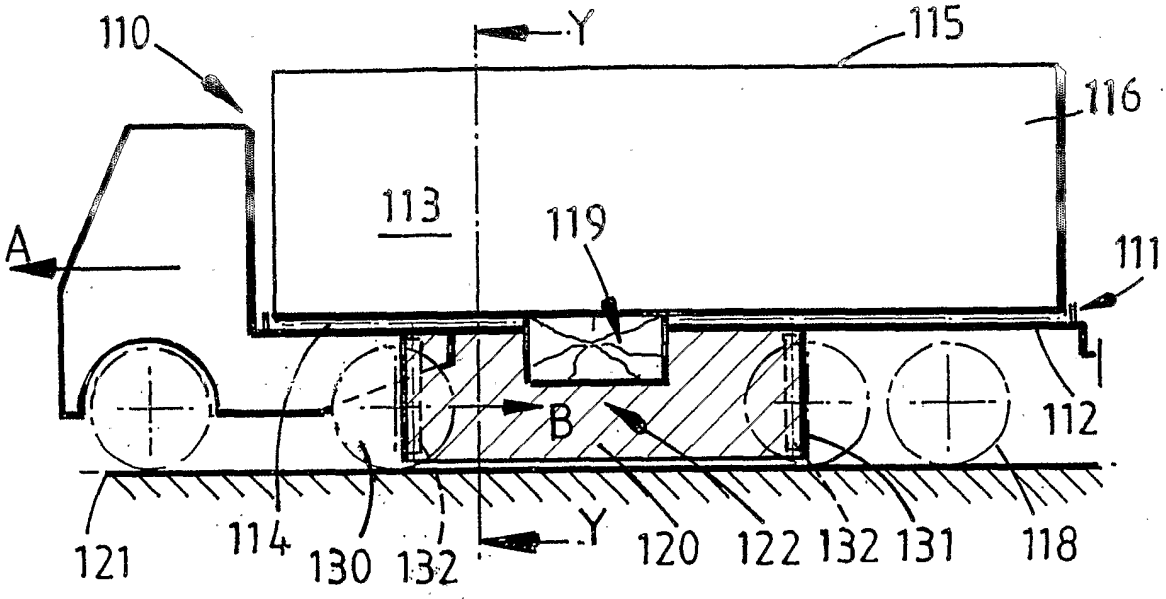
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FIG. 3

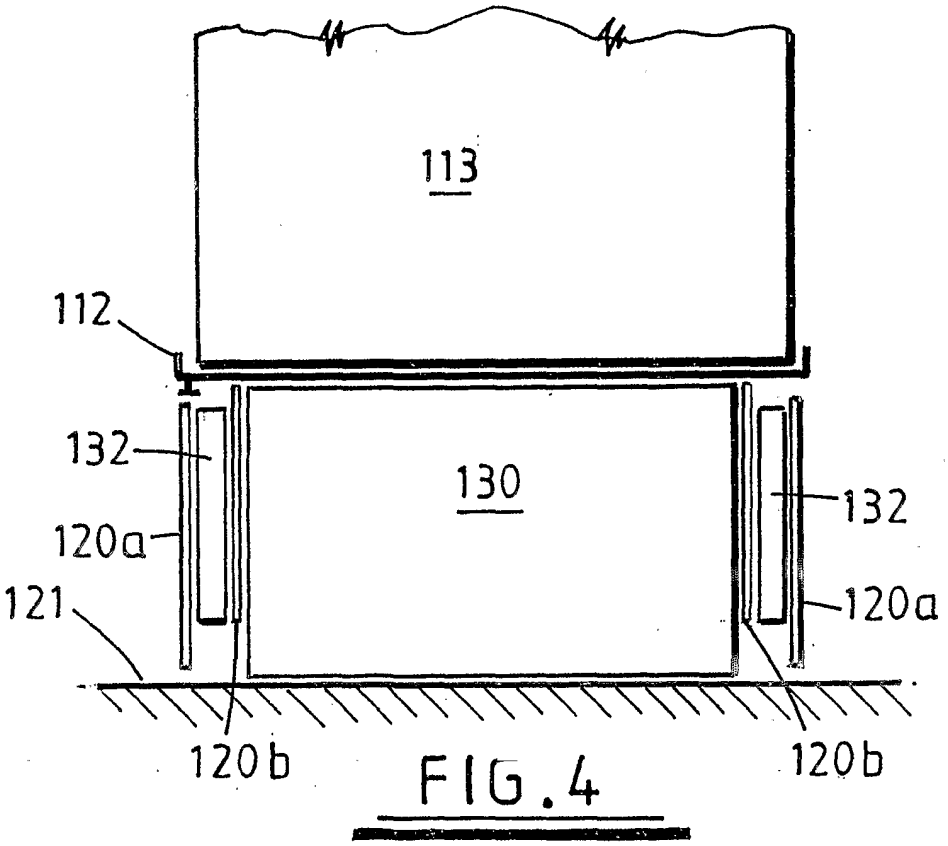
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FIG. 4

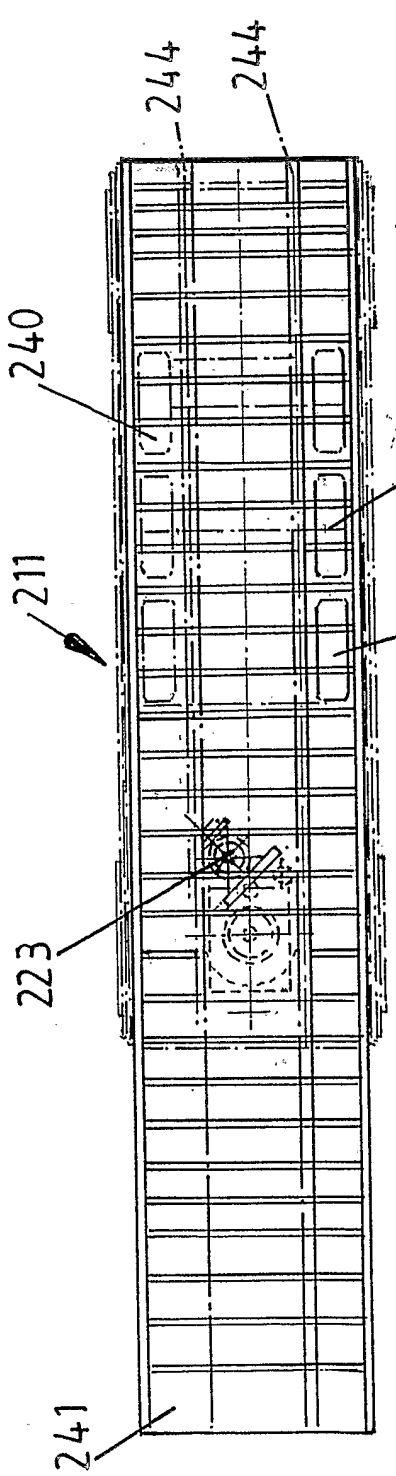
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FIG.5

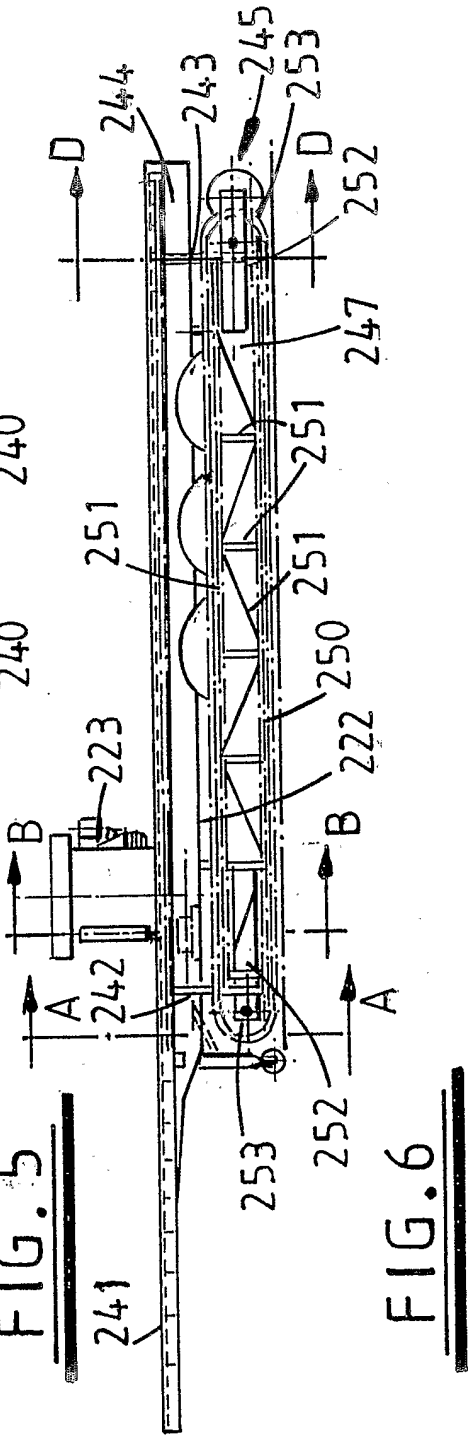
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FIG.6

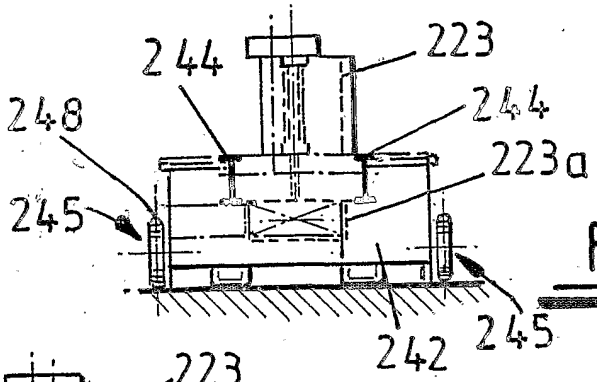

FIG. 7

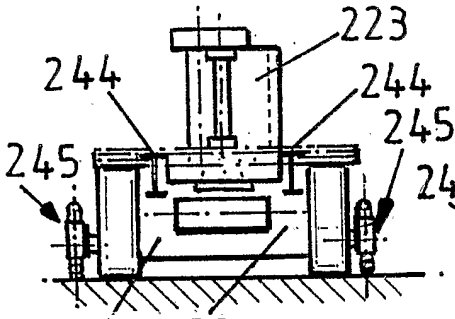

FIG. 8

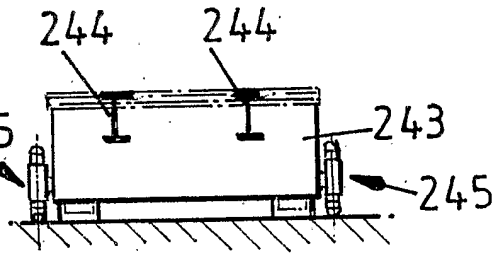

FIG. 9

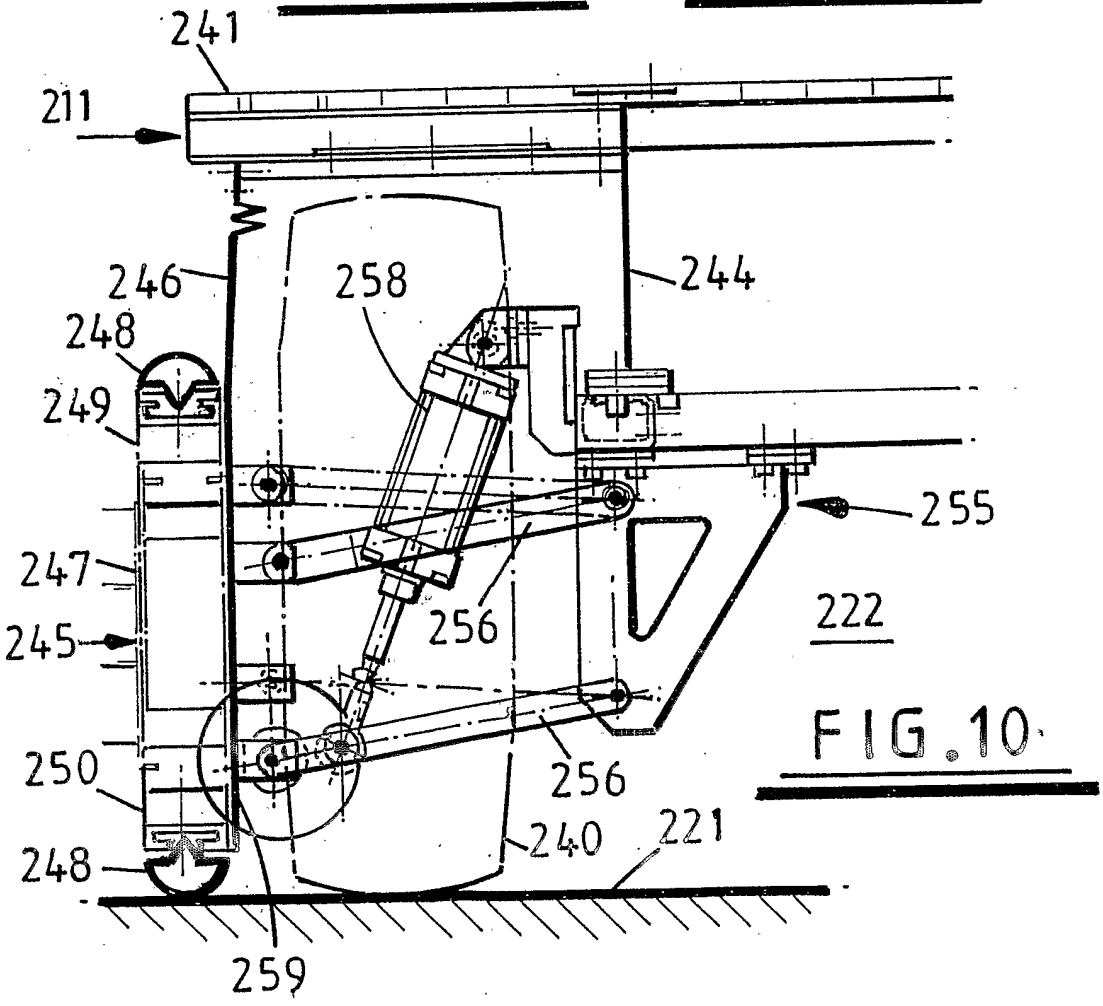

FIG. 10

INTERNATIONAL SEARCH REPORT

ıtional Application No
ıcı/GB2004/001326

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60V3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60V B60P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 334 700 A (PATTISON JOHN W ET AL) 8 August 1967 (1967-08-08)	1-5,7,8, 10-20, 22-24, 26,27
A	the whole document	9,21,25
X	US 3 586 118 A (BERTIN JEAN HENRI) 22 June 1971 (1971-06-22)	1-4,6, 9-11,13, 14,19, 20,22, 23,27
A	column 1, line 61 - line 75 column 2, line 56 - line 66 figures	15,23

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 June 2004	17/06/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Estrela y Calpe, J

INTERNATIONAL SEARCH REPORT

tional Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	page 1, line 50 - line 54 page 1, line 84 - line 102 figures	25
X	US 1 698 482 A (VASA NICIN) 8 January 1929 (1929-01-08)	1-5,7,8, 10,14, 19,22, 23,27
A	column 2, line 67 - line 22 figures	12,13,21

INTERNATIONAL SEARCH REPORT

Information on patent family members

ıtional Application No
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